

A BEGINNER'S GUIDE to the **UNIVERSE**

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Our View from the Earth

This chapter is all about our view of the Universe from the Earth and how this view changes as the Earth and things near the Earth move around.

Maybe you have stood on top of a hill, looked from the top of a tall building, or even looked out of a plane as it is taking off or landing. If you have then you know that you can see a spectacular view. You can see things that are near and things that are far away at the same time. You will have noticed that as things move further away they seem to become smaller. Maybe you have been so high that when you look down on people they look as small as ants. If you look through binoculars or a telescope then you can see much more. You might be able to read the writing on far away signs or see people's faces or watch what animals are doing without them seeing you.

When you look at the night sky you are also seeing a view. Once again you can see many things – some nearer and some further away. Things called **comets**, **meteors**, **asteroids**, the **Sun**, the **Moon** and the **planets** are all quite near to us. They are all in what we call the **Solar System**. Things called **stars**, **nebulae** and **galaxies** are much further away. The view you see on a clear night is what the **Universe** looks like from the Earth.

Perhaps you find it strange to think of anything in the night sky being 'near' to us. Words like 'near' and 'far' can mean different things depending on where you are and what you are doing. If you were at a zoo, then you might say you are 'near' an animal if you could reach out and touch it through the bars of its cage. The word 'near' means an arm's length away. If you were telling someone how to get to your local shop,



All the objects in this photograph are at very different distances from the person who took it. The trees are closest, then the Moon, then Mars (by the trees, on the right), then Jupiter (well above and slightly to the right of the Moon) and then Saturn (at the same height as the Moon to the right).

Image opposite. The constellation of Orion.

you might call it ‘near’ if it was a five-minute walk away. Now the word ‘near’ means much longer than an arm’s length away. Words like ‘near’, ‘far’, ‘small’, ‘big’, ‘hot’ and ‘cold’ all mean different things to different people at different times.

In **Astronomy**, all of these words are used, although the distances and sizes are so huge that you can’t easily imagine them. We say that the Moon is near the Earth because it is much closer to the Earth than anything else in the night sky, but the distance to the Moon is unimaginably larger than the distance to your local shop!

Because the stars are all so far away they don’t seem to move at all. During your whole life you will always see the same star patterns.

The proper name for a pattern of stars is a **constellation**. The photo shows Orion, just one of the constellations. When your grandparents were your age they would have seen exactly the same constellations that you see today. Perhaps one day you will have children and grandchildren. They will all see these same constellations too.



Light-years

When we are talking about distances to stars, we need to know a little about light and how fast it travels. Light is the fastest thing in the Universe. It travels 300 000 kilometres every second. A very fast car would take a month to cover that distance. The Sun is 150 million kilometres from the Earth. It takes just over eight minutes for the Sun's light to reach your eyes. This means you are seeing the Sun as it was eight minutes ago. If the Sun were to blow up – which it won't do – then we wouldn't even know about it until eight minutes after it happened.

All the other stars are very far away from us. They are so far away that astronomers don't even try to talk about the distances in miles or kilometres. Instead, astronomers measure the distances in **light-years**. One light-year is the distance that light travels in one year. It is about 10 000 billion kilometres – far too big a number to imagine. In just four seconds light travels more than a million kilometres!

As well as light-years, you can talk about light-seconds, light-minutes, light-hours and light-days. A light-second is the distance that light travels in a second, a light-minute is the distance that light travels in a minute and so on.

It is important to remember that nothing travels faster than light. Let's imagine we have a spaceship that can travel at the speed of light. Let's also imagine that you set off in it to travel to **Alpha Centauri**, the nearest star to our Sun, starting at 9 o'clock in the morning on your best friend's 10th birthday.

Time	
Hours.Minutes.Seconds	
9.00.00	<i>Your friend waves goodbye to you. You set off.</i>
9.00.01	<i>Your friend blinks once. You are at the Moon.</i>
9.08.33	<i>Your friend sheds a few tears for you. You are further away than the Sun.</i>

10.00.00 *Your friend has spent an hour at school.
You are between Jupiter and Saturn.*

*By 9 o'clock the next morning, when your friend is having breakfast,
you have passed Pluto, the furthest planet from the Sun.
By your friend's 14th birthday you are almost at the nearest star.*

Looking back in time

The star Alpha Centauri is over four light-years away from us, so the light from this star takes over four years to get here. This means that if you look at Alpha Centauri you are seeing light that left the star over four years ago. If a star is ten light-years away, you see it as it looked ten years ago and if a star is 100 light-years away, you see it as it looked 100 years ago. Some of the stars we can see are so far away that their light has taken millions of years to reach us. This means that as you gaze at these stars you are looking back in time.

How far can you see?

On a clear night, without a telescope or binoculars, you can see a fuzzy patch in the constellation **Andromeda**. It is **The Andromeda Galaxy**. It is over two million light-years away from the Earth. You are seeing light which left the Andromeda Galaxy two million years ago. It is the most distant object our eyes can see without a telescope.

Dazzle your friends with your brilliance!

Ask them how far the human eye can see without binoculars or a telescope and watch their surprise as you tell them the answer.